Center Independent Research & Development: JPL IRAD

Towards Sub-mm Level Formation Knowledge and mm-Level Control of Distributed Spacecraft for Earth Remote Sensing Using Small Satellites

Completed Technology Project (2016 - 2018)

Project Introduction

Task to research technologies enabling precision formation flight of small spacecraft in a fuel efficient manner. The task focuses on two key technologies, the first, is building more precise sensors for determining relative spacecraft position, the second, is to build novel Guidance Navigation and Control formation flight architectures.

This tasks matures two technologies needed for Earth sensing distributed spacecraft missions beyond 2025. The first is high performance inter-spacecraft positioning, time-transfer, and communications. The second is the guidance, navigation, and control (GNC) formation flight architectures to leverage this technology and demonstrate fuel-efficient yet precise LEO formation control. Relative Positioning with GPS/GNSS: Modify the miniaturized low-power GPS/GNSS space receiver (uGNSS), developed during a previous task, to demonstrate real-time relative positioning between two spacecraft to sub-centimeter level accuracy. This will be accomplished by passing GNSS carrier phase and range measurements via the inter-spacecraft link, using JPL's Real-Time GNSS-inferred positioning system-x (RTGx) to solve for the inter-spacecraft baselines. Inter-Spacecraft: Ranging, Time Transfer, and Communication: Build a prototype dual-frequency transceiver with commercial off-the-shelve (COTS) components, demonstrating sub-mm relative positioning. This inter-spacecraft link will be used for precise ranging, time transfer, and communications between multiple spacecraft, leveraging software and algorithms developed for GRACE/GRAIL. Formation Flight: The objective of the formation flight (FF) sub-task is to develop prototype GNC architectures that enable economic missions. Through analysis, formation architectures will be assessed based on these new sensing capabilities. The study will directly apply the predicted performance of the inter-spacecraft ranging subsystem being developed in parallel.

Anticipated Benefits

Enables new instrument concepts for planetary and earth missions.

Project Image
JPL_IRAD_Activities Project

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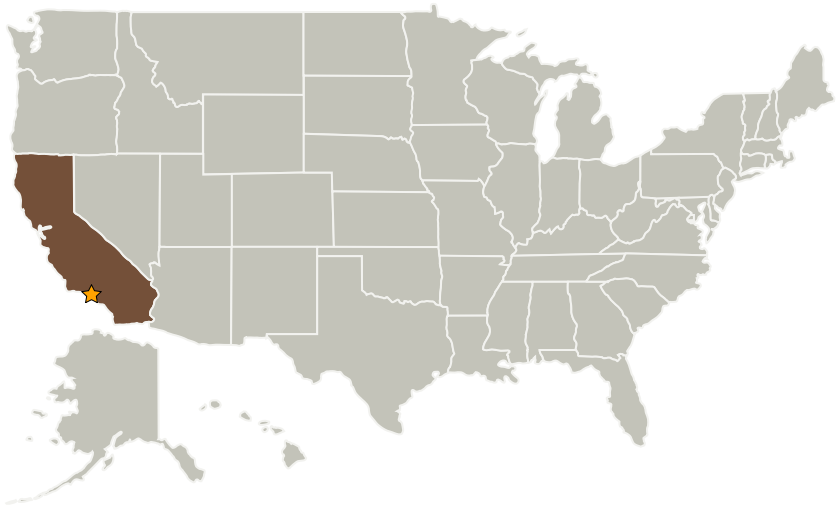
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★Jet Propulsion Laboratory(JPL)	Lead Organization	NASA Center	Pasadena, California

Primary U.S. Work Locations
California

Organizational Responsibility

Responsible Mission Directorate:

Mission Support Directorate (MSD)

Lead Center / Facility:

Jet Propulsion Laboratory (JPL)

Responsible Program:

Center Independent Research & Development: JPL IRAD

Project Management

Program Manager:

Fred Y Hadaegh

Project Manager:

Fred Y Hadaegh

Principal Investigator:

Stephan Esterhuizen

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Jeffrey A Dickson
Angela R Dorsey
Nuno Ricardo Salgueiro Filipe
Daniel P Scharf
Carl Seubert
Jeffrey Y Tien

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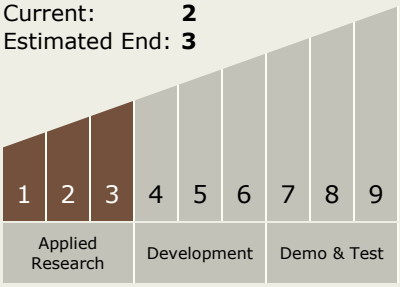
Images

JPL_IRAD_Activities Project Image
Project Image JPL_IRAD_Activities Project
(https://techport.nasa.gov/image/26097)

Technology Maturity (TRL)

Start: **1**
Current: **2**
Estimated End: **3**



Technology Areas

Primary:

- TX08 Sensors and Instruments
  - TX08.2 Observatories
    - TX08.2.3 Distributed Aperture

Target Destinations

Earth, Others Inside the Solar System, Foundational Knowledge

Supported Mission Type

Push